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Newfoundland and Labrador Region

Canadian Science Advisory Secretariat
Science Advisory Report 2016/052

ASSESSMENT OF AMERICAN LOBSTER IN NEWFOUNDLAND

Image: American Lobster (Homarus americanus)

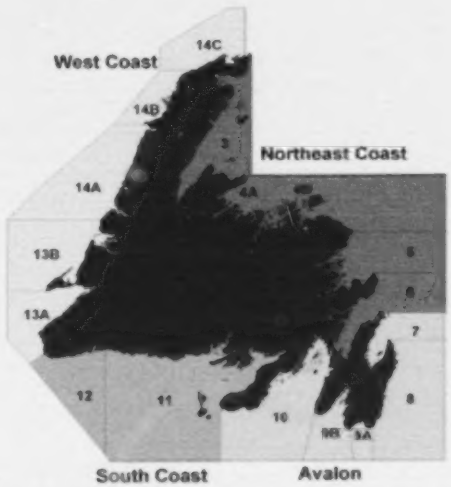

Figure 1. Newfoundland Lobster Fishing Areas (LFAs 3-14) combined into assessment regions

Context:

The American Lobster (Homarus americanus) is distributed near shore around the island of Newfoundland and along the Strait of Belle Isle portion of the Labrador coast. Major life history events (i.e. molting, mating, egg extrusion and hatching) generally take place during mid-July to mid-September, following the fishing season.

The fishery is localized and prosecuted from small open boats during an 8-10 week spring fishing season. Traps are set close to shore, at depths generally less than 20 m. Fishing effort is controlled through restrictive licensing and daily trap limits. Regulations prohibit the harvest of undersized (i.e. <82.5 mm carapace length) and ovigerous animals. In addition, there is a voluntary practice called v-notching, which involves cutting a shallow mark in the tail fan of an ovigerous female. The mark is retained for at least 2-3 molts and notched females cannot be retained in the fishery. The practice thus serves to protect proven spawners even when they are not brooding eggs externally. The number of licenses is currently around 2,450 and trap limits range from 100 to 300 depending on the Lobster Fishing Area (LFA) (Fig. 1).

This stock was last assessed in 2013 and is currently assessed every three years. The present assessment of this stock is requested by Fisheries Management to provide current information on the status of the resource and provide data that will be used in the updated Integrated Fisheries Management Plan. The LFAs were assessed based on four regions (Northeast (LFAs 3-6), Avalon (LFAs 7-10), South Coast (LFAs 11-12) and West Coast (LFAs 13-14)) (Fig. 1). The key indicators for the assessment are reported landings, nominal effort, mean catch per unit effort (CPUE), and relative survival fraction.

This Science Advisory Report (SAR) is from the May 10-11 and May 16, 2016 meeting of the Newfoundland and Labrador Regional Peer Review Process on Lobster. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

November 2016

Canada

SUMMARY

Overall (LFAs 3-14)

- The Newfoundland lobster assessment was completed for four regions which consist of a geographical grouping of LFAs into Northeast (LFAs 3-6), Avalon (LFAs 7-10), South Coast (LFAs 11-12), and West Coast (LFAs 13-14).
- Total reported landings for Newfoundland have remained relatively stable since the 1960s, and were 2,750 t in 2015. Since 2010, landings have decreased in the Avalon, have increased in the South and West Coast regions, and have not changed in the Northeast.
- Nominal effort (based on active fishers, trap limits and fishing days) decreased by 45% since 2006 due to license retirements, fewer active fishers, shorter seasons, and trap limit reductions.
- Catch per Unit Effort (CPUE) has increased gradually over the past decade.
- Most size frequency distributions clearly show a sharp drop at legal size and few lobsters achieving the second molt class, indicating that most of the exploitable biomass is caught in the year of recruitment to the fishery.
- Survival of unprotected lobster (male, non-ovigerous non-v-notched female), relative to protected lobster (ovigerous female), is low. In addition, within the legal size, large lobster survive better than small lobster.
- Since detection in 2007, European green crab may have negatively impacted the resource through predation, competition, and habitat modification. The expansion of green crab in the South Coast region, a high lobster-producing area, has heightened this concern.

Northeast Region (LFAs 3-6)

- Reported landings have declined from about 750 t in the early 1990s to 225 t in 2015.
- Nominal effort has decreased by 16% since 2012 due to fewer active fishers.
- Mean CPUE based on logbook data increased gradually from 2004 to 2015.
- Relative to protected (ovigerous) females, survival over the fishing season for male lobster has remained unchanged (at around 20%) and for unprotected (non-ovigerous) female lobster has increased slightly (to around 20%) in recent years.

Avalon Region (LFAs 7–10)

- Reported landings have declined from about 460 t in the early 1990s to about 30 t in 2015.
- Nominal effort has decreased by 32% since 2012 due to fewer active fishers.
- Mean CPUE based on logbook data increased gradually from 2005 to 2015.
- Relative to protected (ovigerous) females, survival over the fishing season for both male and non-protected (non-ovigerous) female lobster has increased from about 10% before 2012 to about 30% since 2012.

South Coast Region (LFAs 11–12)

- Reported landings increased from about 400 t in the early 1990s to about 1,200 t in 2015.

- Nominal effort has decreased by 15% since 2012 due to license retirements, and fewer active fishers.
- Mean CPUE based on logbook data has increased gradually from 2005 to 2015.
- Relative to protected (ovigerous) females, survival over the fishing season for both male and non-protected (non-ovigerous) female lobster has fluctuated around 20% since 2004.

West Coast Region (LFAs 13–14)

- Reported landings have varied without trend since the early 1990s and were about 1,300 t in 2015.
- Nominal effort has decreased by 15% since 2012 due to license retirements, and fewer active fishers.
- Mean CPUE based on logbook data has increased gradually from 2004 to 2015.
- Relative to protected (ovigerous) females, survival over the fishing season for both male and non-protected (non-ovigerous) female lobster has fluctuated around 5% since 2004.

BACKGROUND

Species Biology

The American Lobster (*Homarus americanus*) is a decapod crustacean characterized by a life cycle which is predominately benthic. Lobsters may live for more than 30 years (Lawton and Lavalli 1995). In Newfoundland waters, at the northern range of the species distribution, it takes about 8-10 years for a newly hatched lobster to reach the minimum legal size (MLS) of 82.5 mm in carapace length (CL). Growth is achieved through molting, and frequency of molting decreases with increasing age. Growth is also affected by temperature, as molting probability tends to increase with water temperature.

Molting and mating occur in the months of July to September, and females typically extrude (spawn) eggs roughly one year subsequent to mating. Ovigerous (egg bearing) female lobsters carry the eggs in clutches on the underside of their tail, protecting and maintaining the eggs for 9-12 months. Thus, female lobsters are typically characterized by a biennial molt-reproductive cycle, though smaller mature females sometimes molt and spawn within the same year. Fecundity and egg quality increase with size. Hatching occurs during a four month period extending from late May through most of September. Once released, the larvae swim upward and undergo a series of three molts during their 4-6 week planktonic phase, during which most mortality is thought to occur. With the third molt, a metamorphosis occurs and the newly developed postlarvae, which resemble miniature adults, are prepared to settle to the benthic environment. Newly-settled lobster progress through several stages before reaching sexual maturity.

The adult lobster is thought to have few natural predators and commercial harvesting accounts for most adult mortality. Diet typically consists of rock crab, polychaetes, molluscs, echinoderms, and various finfish.

The Fishery

The American Lobster fishery in Newfoundland dates back to the early 1870s. The fishery is prosecuted from small open boats. Traps are set close to shore, at depths generally less than 20 m. Effort was uncontrolled up to 1976, at which point a limited-entry licensing policy was

implemented, and trap numbers were regulated. The minimum legal size was increased from 81 mm CL to 82.5 mm CL in 1998.

Following the implementation of the 1998-2002 management plan, there was a 25% reduction in licenses in the Newfoundland lobster fishery. Reductions in trap limits, season lengths and licenses issued were put in place as deemed necessary by fishery managers. In recent years, a Lobster Enterprise Retirement Program and the Atlantic Lobster Sustainability Measures program were implemented. These programs have led to license and trap limit reductions in the Newfoundland lobster fishery, particularly in the South and West Coast regions.

There are currently about 2,450 licenses with trap limits varying from 100 to 300 per licensed fisher, depending on LFA. Traps must possess vents which allow undersized lobster to escape. Regulations prohibit the retention of undersize animals, as well as ovigerous and v-notched females.

Reported landings peaked at almost 8,000 t in 1889 (Fig. 2). Early documentation indicates that all lobsters captured were landed and processed by small canning operations that existed around the coast. A stock collapse occurred in the mid-1920s, after which the fishery was closed for three years, from 1925 to 1927. The fishery reopened in 1928, and reported landings reached over 2,000 t, but dropped sharply the following year. In the early 1930s, regulations were introduced to protect undersized and ovigerous animals.

Total reported landings for Newfoundland have remained relatively stable since the 1960s (Fig. 2). However, reported landings do not account for local sales, poaching, and handling mortalities that can occur prior to the sale of the catch. The extent of local sales, in particular, can be considerable and varies by location and year. In the last few years, reported landings have decreased in the Avalon region, have increased in the South and West Coast regions and have not changed in the Northeast region.

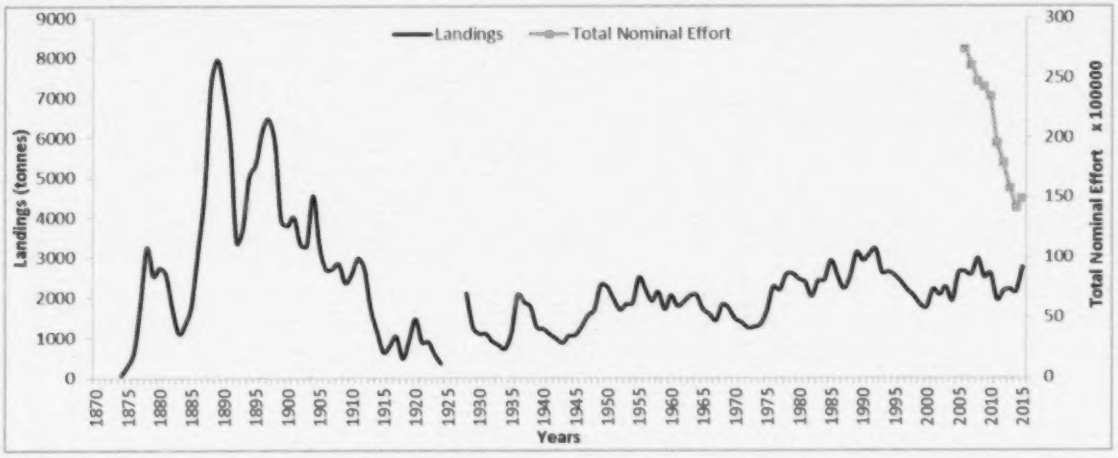

Figure 2. Trends in reported landings and total nominal effort (based on active fishers, trap limits and fishing days) for the Newfoundland lobster fishery.

ASSESSMENT

The Newfoundland lobster assessment was completed for four regions which are a geographical grouping of LFAs: Northeast (LFAs 3-6), Avalon (LFAs 7-10), South Coast (LFAs 11-12), and West Coast (LFAs 13-14) (Fig. 1). All data available for assessing lobster in Newfoundland are fishery-dependent and each LFA/region has varying data sources including: reported landings; nominal effort; DFO logbooks; Fish, Food and Allied Workers Union (FFAW) index logbooks; and at-sea sampling data.

Total reported landings for Newfoundland have remained relatively stable since the 1960s, and were 2,750 t in 2015 (Fig. 2). Since 2010, landings have decreased in the Avalon, have increased in the South and West Coast regions, and have not changed in the Northeast region.

At-sea sampling data were used to generate size frequency distributions for males and females within each region (Fig. 3). Most size frequency distributions clearly show a sharp drop at legal size and few lobsters achieving the second molt class, indicating that most of the exploitable biomass is caught in the year of recruitment to the fishery (Fig. 3).

At-sea sampling data were also used to calculate relative survival within a fishing season. These data typically show a marked decrease over the fishing season in the ratio of unprotected categories of lobster (males, non-ovigerous females) to ovigerous females which are protected. The trend can be well represented by a linear decrease in the logarithm of the ratio, fitted by weighted (by the sample size of the denominator) least squares. The fractional difference in predicted ratio at the beginning and end of the fishing season is then interpreted as the relative survival fraction of the numerator category (relative to the denominator category). The actual survival fraction will be less than this, because the denominator category itself will suffer some mortality (Fig. 4). Survival of unprotected lobsters (male, non-ovigerous non-v-notched female), relative to protected lobster (ovigerous females), is low. Among legal sized lobsters N1 is the first molt class and N2 is the second; of these two groups, large lobsters (N2) survive better than small lobsters (N1) of the same category (e.g. males, non- ovigerous females).

FFAW index logbook data, available since 2004, were used to compute CPUE (number of lobster caught/number of traps hauled) annually within regions. DFO logbooks were implemented in the Newfoundland lobster fishery starting in 2010. CPUEs were calculated from the DFO logbooks and comparisons with FFAW index logbook data showed similar trends except for slightly higher CPUEs based on the DFO logbooks in 2014 (e.g. Fig. 7). Overall, CPUE increased gradually since 2004.

FFAW index logbooks were also used to calculate the percentage of v-notching (number of ovigerous females v-notched/total ovigerous females) annually for all regions. On average, the extent of v-notching ranged from 4% to 25% (Fig. 5).

Nominal effort is the maximum potential number of trap hauls within a region during a fishing season: the product of the number of active fishers, the daily trap limit and the length of the fishing season in days. Nominal effort has decreased by 45% since 2006, due to license retirements, fewer active fishers, shorter seasons, and trap limit reductions (Fig. 2).

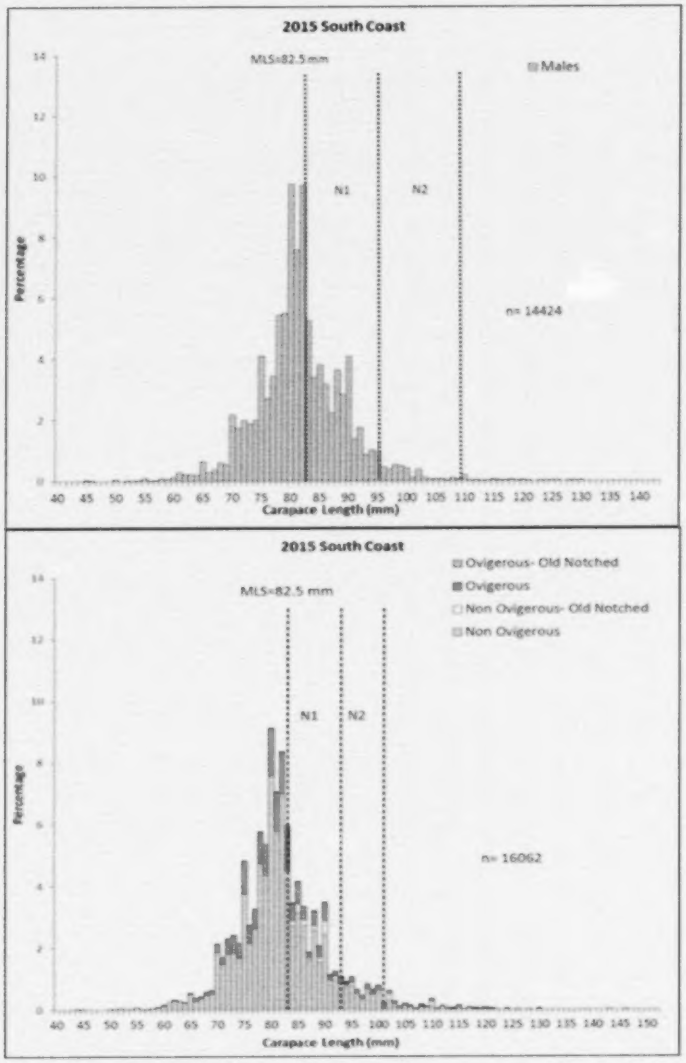

Figure 3. Typical size frequency distributions for males (top panel) and females (bottom panel), from the South Coast region (for illustrative purposes). N1 are small legal sized lobsters (first molt class) and N2 are large (second molt class).

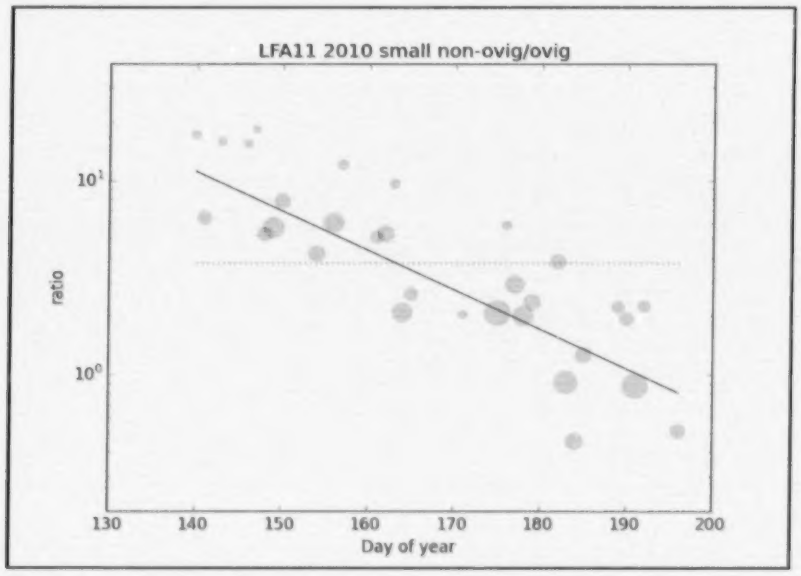

Figure 4. A graph outlining components of the relative survival fraction methodology. The expanding circles represent samples of non-ovigerous and ovigerous small (N1) females over the course of a fishing season; the area of a symbol is proportional to the number of ovigerous females in the sample; the y-coordinate is the ratio of non-ovigerous to ovigerous. The solid line represents the weighted least-squares fit; and the dotted line indicates the ratio of the two numbers for all samples combined.

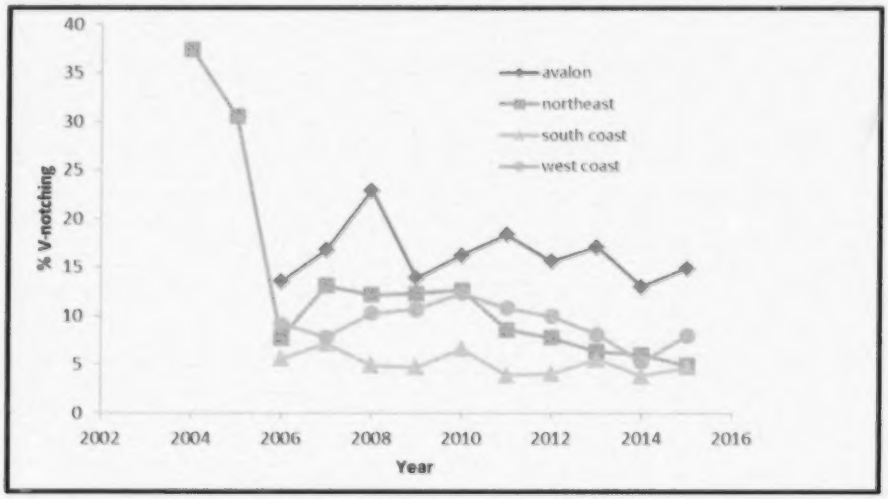

Figure 5. Percent v-notching for each region from 2004-15.

Northeast Region (LFAs 3-6) Resource Status

Reported landings have declined from about 750 t in the early 1990s to 225 t in 2015 (Fig. 6). Nominal effort has decreased by 16% since 2012 due to fewer active fishers (Fig. 6). Mean CPUE based on logbook data increased gradually from 2004 to 2015. (Fig. 7)

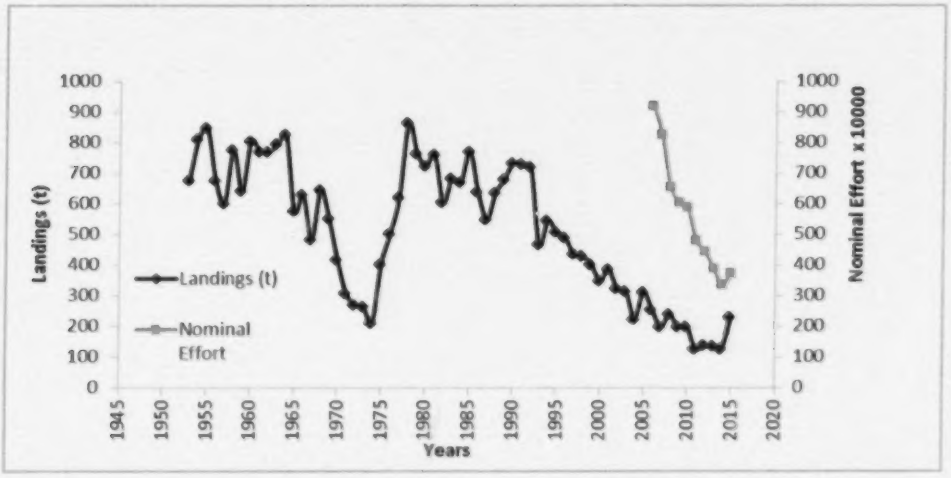

Figure 6. Trends in reported landings and nominal effort in the Northeast region.

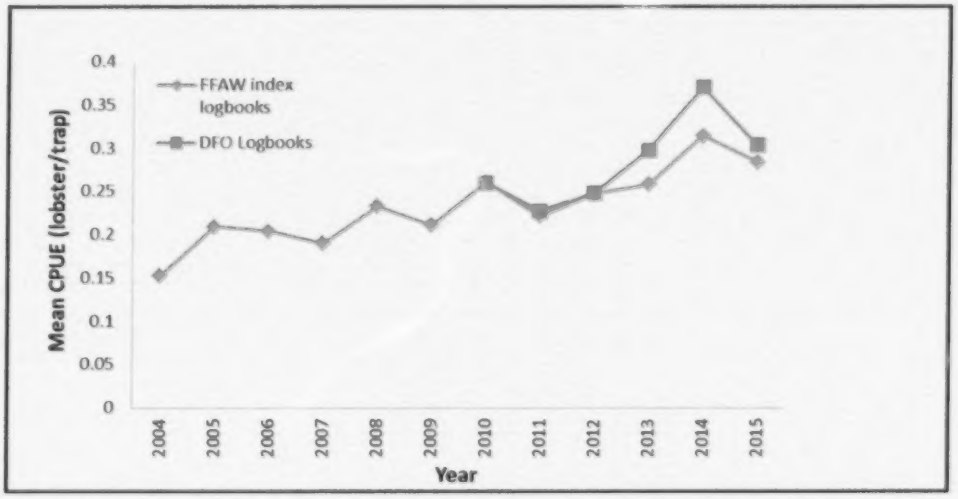

Figure 7. Mean CPUE from the Index Fishers Logbooks and DFO Logbooks for the Northeast region.

Relative to protected (ovigerous) females, in recent years survival over the fishing season for males has remained unchanged (at around 20%) and for unprotected (non-ovigerous) females has increased slightly (to around 20%; Fig. 8). Moreover, within the legal size, large lobsters survive better than small lobsters of the same category (e.g. males, non-ovigerous females).

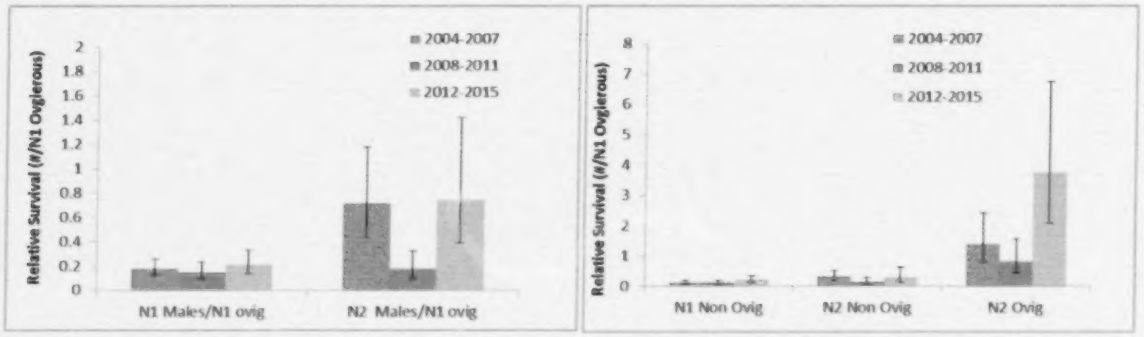

Figure 8. Relative survival fraction for male (left panel) and female lobsters (right panel) in the Northeast region. N1 are small legal sized lobsters (first molt class) and N2 are large (second molt class).

Avalon Region (LFAs 7-10) Resource Status

Reported landings have declined from about 460 t in the early 1990s to about 30 t in 2015 (Fig. 9). Nominal effort has decreased by 32% since 2012 due to fewer active fishers. Mean CPUE based on logbook data increased gradually from 2005 to 2015 (Fig. 10).

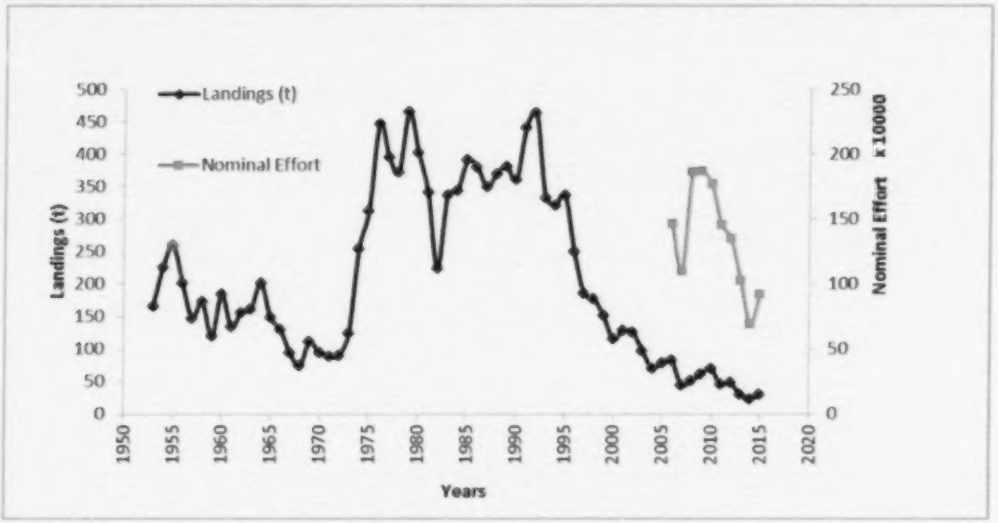

Figure 9. Trends in reported landings and nominal effort in the Avalon region.

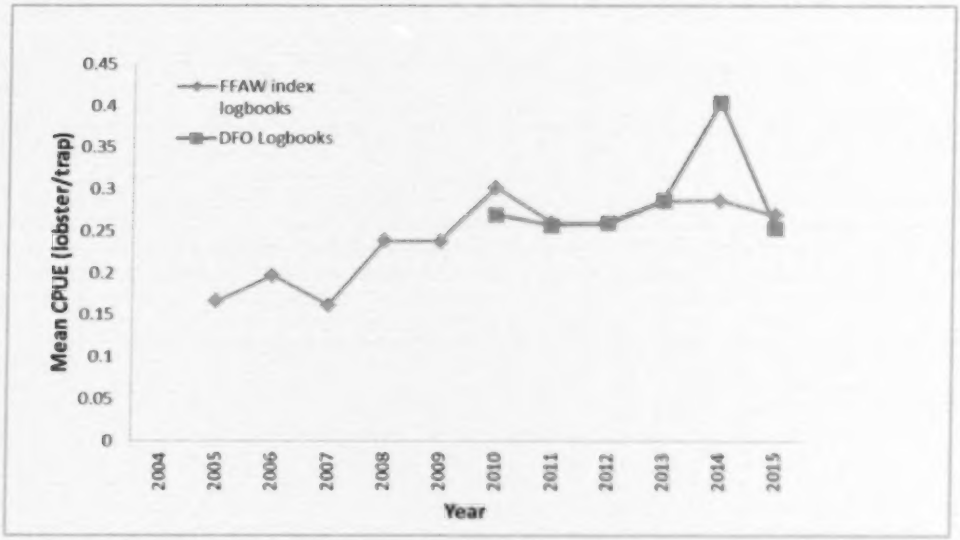

Figure 10. Mean CPUE from the Index Fishers Logbooks and DFO Logbooks for the Avalon region.

Relative to protected (ovigerous) females, survival over the fishing season for both male and non-protected (non-ovigerous) females has increased from about 10% before 2012 to about 30% since 2012 (Fig. 11).

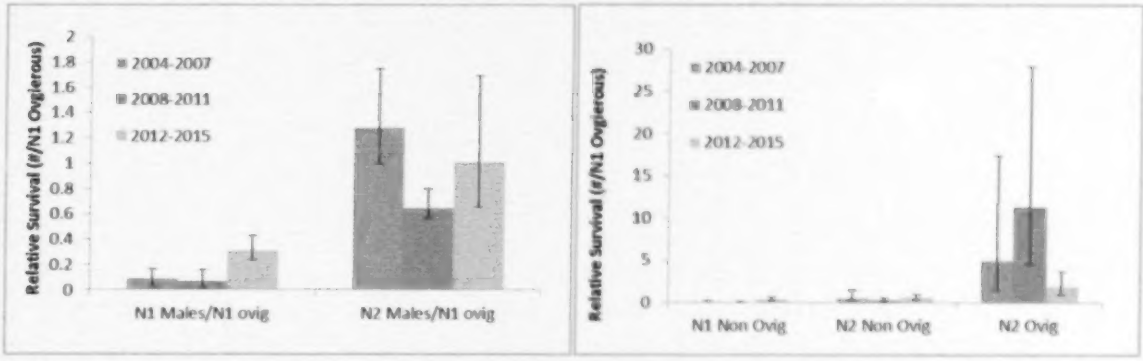

Figure 11. Relative survival fraction for male (left panel) and female (right panel) lobsters in the Avalon region. N1 are small legal sized lobsters (first molt class) and N2 are large (second molt class).

South Coast Region (LFAs 11-12) Resource Status

Reported landings increased from about 400 t in the early 1990s to peak at 1,200 t in 2015. (Fig. 12). Nominal effort has decreased by 15% since 2012 due to license retirements, and fewer active fishers (Fig. 13). Mean CPUE based on logbook data has increased gradually from 2005 to 2015 (Fig. 13).

Figure 12. Trends in reported landings and nominal effort in the South Coast region.

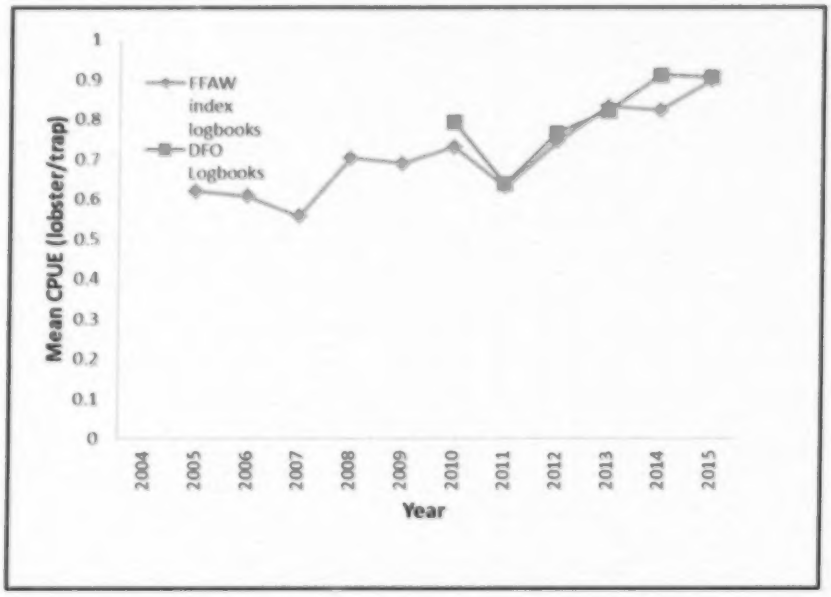

Figure 13. Mean CPUE from the Index Fishers Logbooks and DFO Logbooks for the South Coast region.

Relative to protected (ovigerous) females, survival over the fishing season for both male and non-protected (non-ovigerous) female lobster has fluctuated around 20% since 2004 (Fig. 14).

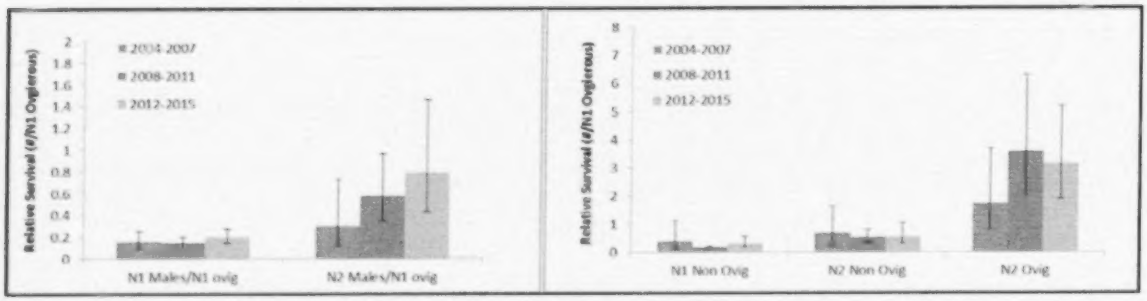

Figure 14. Relative survival fraction for male (left panel) and female (right panel) lobsters in the South Coast region. N1 are small legal sized lobster (first molt class) and N2 are large (second molt class).

West Coast Region (LFAs 13-14) Resource Status

Reported landings have varied without trend since the early 1990s and totaled 1,200 t in 2015 (Fig. 15). Nominal effort has decreased by 15% since 2012 due to license retirements and fewer active fishers (Fig. 15). Mean CPUE based on logbook data has increased gradually from 2004 to 2015 (Fig. 16).

Figure 15. Trends in reported landings and nominal effort in the West Coast region.

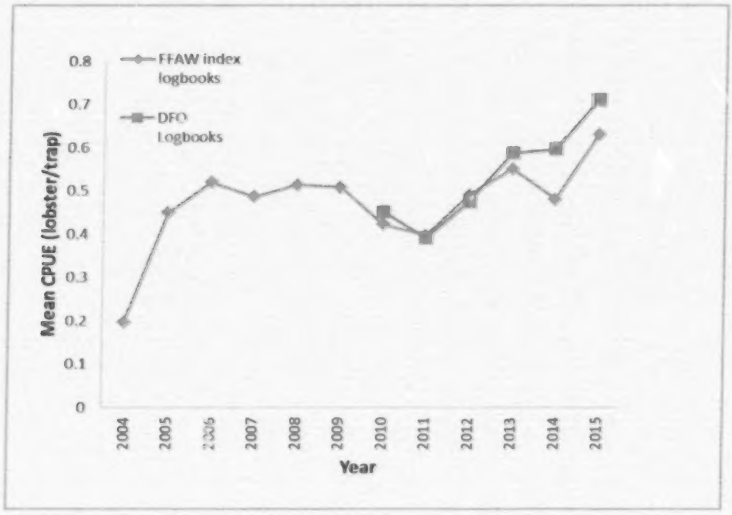

Figure 16. Mean CPUE from the Index Fishers Logbooks and DFO Logbooks for the West Coast region.

Relative to protected (ovigerous) females, survival over the fishing season for both males and non-protected (non-ovigerous) females has fluctuated around 5% since 2004 (Fig. 17).

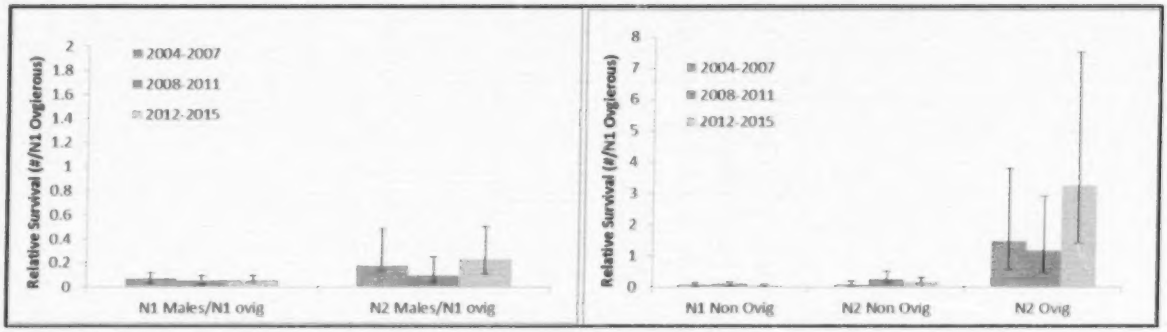

Figure 17. Relative survival fractions for male and female lobsters in the West Coast region. N1 are small legal sized lobsters (first molt class) and N2 are large (second molt class).

Sources of Uncertainty

The assessment is based solely on fishery-dependent data. Reported landings do not account for local sales, poaching, and handling mortalities that can occur prior to the sale of the catch. The extent of local sales, in particular, can be considerable and varies by location and year.

For the at-sea sampling data, effects of year to year differences in spatial and temporal coverage are unknown.

Differences in catchability among sizes and categories, as well as density-dependent effects, can complicate the interpretation of at-sea sampling data. Environmental conditions, soak time, and changes in fishing gear can also affect catchability. There are vast changes in relative amounts of size categories over the fishing season; therefore size data aggregated over the entire fishing season are difficult to interpret.

Returns of DFO logbooks, from which CPUE is calculated, have been very low. This limits the use of CPUE as an index of fishery performance. A decrease in the number of active fishers will reduce gear competition and could result in an increase in CPUE.

Methods for inferring the relative survival fraction of v-notched females during the fishing season need to be refined. The act of v-notching changes the proportions of v-notched and non-notched females in a manner unrelated to survival. Survival calculations currently do not take that into account.

V-notching of ovigerous female lobsters has been taking place annually since the mid-1990s. The extent to which v-notching is being practiced is uncertain. If there is a positive effect of this practice on recruitment, it has not yet become clear.

CONCLUSIONS

Most size frequency distributions clearly show a sharp drop at legal size and few lobsters achieving the second molt class, indicating that most of the exploitable biomass is caught in the year of recruitment to the fishery. Nominal effort has decreased by 45% since 2006. CPUE has increased gradually over the past decade. Overall the survival of unprotected lobsters (males, non-ovigerous, non-v-notched females), relative to protected lobsters (ovigerous females), is low. Moreover, within the legal size, the survival of large lobsters is better than small lobsters.

OTHER CONSIDERATIONS

Green Crab (*Carcinus maenas*)

There are concerns about how green crab may negatively impact the lobster resource through predation, competition and habitat modification, especially since the presence of this invasive species has expanded throughout the South Coast (a high lobster-producing area).

SOURCES OF INFORMATION

This Science Advisory Report is from the May 10-11 and May 16, 2016 regional peer review on the Assessment of American Lobster in Newfoundland. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Attard, J. and Hudon, C. 1987. Embryonic development and energetic investment in egg production in relation to size of female lobster (*Homarus americanus*). Can. J. Fish. Aquat. Sci: 44: 1157-1164.

Factor, J.R. 1995. The Biology of the American Lobster *Homarus americanus*, San Diego California. Academic Press Inc.

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